Dr. Marc Gets a Piece of the Sky

By Diane K. Fisher

> *"Thank you for calling the Deep Space 1 mission status information line, unanimously considered throughout the solar system, except in the upper atmosphere of Neptune and in several counties in Florida on Earth, to be the most reliable source of information on this adventurous mission of exploration. This message was recorded at 3:00 pm Pacific Time on Sunday, December 3.*
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> *"Deep Space 1 has flawlessly completed another challenging phase of its remarkable journey through the solar system . . ."*

So begins another message recorded by Dr. Marc Rayman, manager of the Deep Space 1 extended mission. Since the spacecraft was launched October 24, 1998, a part of Rayman has traveled with it and seen the universe through its eyes.

As the time neared for the autonomous course correction maneuver that would bring DS1 within a few kilometers of Asteroid Braille on July 28, 1999, the spacecraft suddenly developed a problem that caused it to go into safe mode and its computer to reboot. With a critical course correction point approaching, the mission team had to solve the problem, get the computer and all the spacecraft subsystems and instruments back online, calculate the course correction for the spacecraft, and upload the instructions. If they missed the "deadline," there would be no hope of collecting any information on the asteroid. The mission log entry recorded the day following that harrowing experience reflects Rayman's breathless passion for his work, his mission, and his team.

> *"Working against the clock the entire time, the operations team sent the last command to the spacecraft with only 4 minutes to spare before it had to turn its antenna away from Earth to execute the course correction. In fact, while all this was going on, DS1 continued rushing toward Braille at a speed of over 9.6 miles every second. From the time the spacecraft entered standby until the last command was sent by the operations team, the spacecraft moved well over half a million kilometers or more than 300,000 miles closer to Braille. That's more than the distance between Earth and the moon.*
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> *"Once DS1 turned, the operations team could only watch anxiously."*

An astronomy and space exploration buff for as far back as he can remember, Rayman has new reason to rejoice as he gazes up at the sky. Somewhere out there is an asteroid, a huge chunk of rock, a *minor planet* for goodness sake, named for him.

Dr. Helin Shares the Wealth

Asteroid 10050 1987 MA_1 was discovered by Dr. Eleanor Helin and her Palomar Planet-Crossing Asteroid Survey team. With the stability of the asteroid's orbit finally

confirmed and reconfirmed, it is ready for a permanent, more memorable, name. Helin, now a planetary scientist and astronomer at the Jet Propulsion Laboratory (JPL) and principle investigator of the Near-Earth Asteroid Tracking program, wished to honor Marc Rayman for his contributions and dedication to space exploration. Her proposal was accepted by the International Astronomical Union, and the name is now official.

"I am fantastically rich, far beyond my wildest dreams of avarice!" exclaims Rayman. "I'm thinking I might put a few cubic kilometers for sale on eBay."

After spending a little time with Rayman, one realizes that this man does not need to "own" an asteroid or even a monetary fortune to feel fantastically rich. For Rayman appears to be the epitome of self-actualization.

Neither Man nor NASA is the Center of the Universe

On the back of his 1983 Nissan Pulsar, printed in white letters on a red background, is a large bumper sticker that reads "If this sticker is blue, you are driving too fast."

One good-sized room in the modest home near JPL that Rayman owns with his wife, Janice, is devoted to space exploration. Rayman began the collection contained in this room when he was 10 years old. It has grown to include books (over 700), publications (12 file drawers full), models, and other memorabilia from all space-faring nations (of which few people know there are over 40), including Eastern and Western Europe, Russian, Kazakhstan, Brazil, People's Republic of China, Cuba, India, Israel, Saudi Arabia, and many others. Nothing as blatant as a giant model of a Saturn V interrupts the quiet reverence of this shrine to what Rayman deeply feels as the greatest of human endeavors. Rather, one finds such keepsakes as a model of the Russian Luna 3 spacecraft, which in 1959 sent back the first pictures of the far side of the moon; detailed globes of the moon and Mars; food packets from the 1981 joint Soviet-Mongolian space flight; and, one of Rayman's favorites, a framed certificate he received in second grade for having bought a savings bond that declares him a "Space Minute Man of the United States of America and thereby helping to preserve the peace of the free world and making an investment in the future peaceful exploration of space."

As his detailed and dramatic DS1 mission logs might hint, Rayman is an enthusiastic communicator with the public about astronomy and the space program. He has written on Apollo, Skylab, shuttle missions, piloted and robotic missions of the former USSR, planetary missions, and a variety of topics in astrophysics, cosmology, and space exploration. These articles have been written for newspapers, magazines, encyclopedias, and reference books.

He has also lent his name, technical guidance, and persona to "The Space Place," one of NASA's premier web sites for educational outreach to children (http://spaceplace.jpl.nasa.gov). "Dr. Marc" appears regularly on the site as a cartoon character who explains concepts and spreads an aura of credibility over the entire enterprise.

But Rayman is far from being a lop-sided space geek caricature. His world starts at his feet and extends to the edge of the Universe—and he pays close attention to it all.

Collecting Outcomes of the Darwinian Algorithm

Another emblem of self-expression on that aging Pulsar is a DARWIN fish symbol.

The life sciences also get excellent representation in his and Janice's home. Janice, a Ph.D. in cognitive psychology, does brain research at UCLA. And the Raymans' interests appear as well-balanced as the left and right hemispheres of a healthy human brain. A glass-doored closet under the stairs is devoted to Zvyozdochka, a 50-inch-long iguana long-since rescued from abuse. The name translates to "Little Star," the name of the Russian dog launched into space aboard Sputnik 10 in 1961. Other pets are cats Regulus and Milky Way—so named, because Rayman and his wife suspect she has a 2.6-million-solar-mass black hole at her center. Although technically indoor cats, they have a cat-ample-diameter, 50-foot long transparent tube—sort of like a feline habitrail—that takes them outside, over the house, and into another sort of kitty apartment on the opposite side of the house. Zvyozdochka has a similar outdoor run and private apartment.

The couple have no human children (if you couldn't guess).

What was formerly a 30-foot long kidney-shaped swimming pool in the not-much-bigger backyard is now a complex, ecologically balanced Amazonian lagoon complete with island. Participating in the little self-contained ecosystem are papyrus, water iris, water lilies, horsetail rush, pickerel plants, algae, mosquito fish, gold fish, koi, dragon flies, damsel flies, frogs, and many other species.

. . . And a Bow to the Arts

Rayman's own exquisite photographs anoint every wall that isn't already anointed with space exploration art. These are macro-lens close-ups of a brilliant red dragonfly, a splendid argiope spider on her web, a tiny frog with a big smile, another dragonfly with her just-shed exoskeleton—all creatures that live peacefully in the Raymans' back yard. Other photos show considerably more depth of field, including one of his wife on a peak overlooking Yosemite, and a double exposure of a white-blossoming bush in the foreground with a huge, splotchy, perfectly focused, nearly full moon above.

But space and astronomy have been the primary challenges in Rayman's life from the start.

Of Humble but Auspicious Beginnings . . .

Born in Toledo, Ohio, in 1956, of a librarian mother and a postal worker father, Rayman notes that he was 359 days old when Sputnik was launched. He sees that event as the

earliest one marking the direction and purpose of his life, even if he didn't know it yet. He remembers at age 4 or 5, casually walking into the living room and asking his father what was on TV. "They're launching a man into space," his father replied. Rayman hasn't pinpointed the event any more than to say, "It must have been an early Mercury mission, perhaps even Alan Shephard's flight. But I remember it as the event that hooked me on space.

The sky held fascination, mystery, and even terror for young Marc. The first time he saw a shooting star, a meteor, he thought it was a witch. He was scared of all things witchy (including a neighbor lady), but says, "When I learned what the meteor really was, it got me thinking about the universe in a calm and even respectful way."

Although his parents were supportive, there was really no adult in his early life to guide and nurture his interest. By junior high, however, he had gained the internal resources to guide himself. At home, he stumbled upon on an old 20x spotting scope in his parents' basement and pointed it toward Jupiter. "I might have been Galileo all over again. It opened a whole new universe to me," he recalls. He then bought himself an ancient 60-mm refractor telescope, and, from that point on, made a habit of getting up 2 or 3 times a week to go out and look at the stars for hours at a time.

Mentors Found

He joined a local astronomy club—the only child member—and was finally in the company of adults who shared his interests, were eager to help him, and who took him as seriously as they took each other. He was no longer just a kid asking annoying questions that adults would brush off because they didn't know the answers.

At age 15, Rayman went to his first conference: The Great Lakes Astronomy Symposium. There he met Grote Reber of radio astronomy fame, and Peter van de Kamp, first to (erroneously) claim discovery of an extrasolar planet. A photograph of Rayman with the two men was published in *Sky and Telescope* in August 1971.

This is the kind of recognition at a young age that tends to cement one's identity.

Distinguished Education Opens Most—but Not All—Doors

Rayman earned his undergraduate degree from Princeton, majoring in physics, focusing on astrophysics and cosmology. His master's was in physics from the University of Colorado in Boulder, with research in nuclear physics. He earned his Ph.D. and did post-doctoral work in special relativity and atomic and laser physics at the Joint Institute for Laboratory Astrophysics operated by the University of Colorado and the National Institute of Standards and Technology.

In 1986, Rayman took his technical training to space. He joined the Jet Propulsion Laboratory working on optical (laser) communications technology for deep space. In 1990, he broadened his career to more closely match his broad interest in space

exploration. Still at JPL, he helped design future Earth-orbiting and moon-based astrophysics missions using interferometry, then progressed to lead studies of space-based interferometry missions. This is the technology that promises to find planets around other stars and contribute greatly to our understanding of astrophysics—two burning issues in Rayman's view of the Universe.

Meanwhile, Rayman didn't see any good reason why he shouldn't become an astronaut. He had the technical expertise. With a Black Belt in karate and regular enjoyment of hiking, mountaineering, cross-country skiing, and folk dancing, he was healthy, fit, and agile. He had spent lots of time and money on flying lessons.

He was passionate and articulate about the space program. He wanted to be an astronaut more than anything. There was just one tiny problem. His eyesight wasn't perfect. When his vision was 20/150, NASA's requirement was 20/100. Then when they relaxed the uncorrected vision requirement to 20/150, Rayman's error had increased to 20/200. Then when they relaxed it to 20/200, Rayman's was 20/400. No vision correction surgery techniques yet invented were acceptable to NASA. So for two years, Rayman tried orthokeratology (reshaping the cornea by wearing special hard contact lenses at night), a technique NASA did find acceptable. Then they changed their minds.

More Than One Road to Space

Rayman finally gave up on the astronaut idea, but found something else he considered both rewarding and important. He had the opportunity at JPL to work on a new NASA program to evaluate highly advanced and risky technologies for future space missions by flying them on dedicated test missions. That was the beginning of his involvement on Deep Space 1, whose primary new technology was the ion propulsion engine. "In the first Star Trek series, Captain Kirk and Scotty talk about an alien ship's ion engines," he recalls. "We don't know if we'll ever have Star Trek-like warp drive engines, but at least one science fiction technology is now fact. Ion-drive engines are so fuel efficient that they can keep thrusting continuously, eventually building up to greater speeds than we ever could before with chemical propulsion." (Learn more about this and other advanced technologies tested on DS1 at http://nmp.jpl.nasa.gov/ds1.)

Keeping the Universal View

With his study and understanding of the space endeavors of not only the U.S., but every other nation that has made any attempt at all at their own space programs, Rayman distinguishes space missions by their motivators. Some nations, like India, undertake missions that will lead to practical solutions to problems of land use and development, agriculture, and communication. He concludes, "One of the luxuries of living in a prosperous nation is that we can undertake grand adventures. NASA undertakes projects at the limits of our capability and inspires awe in people of all nations. I feel that this effort is very worthwhile."

Now, when Rayman looks up at the night sky, he, personally, has more reason than ever to be awed. He says, "It's amazing to look up and think about what we've sent out there. Up until a few tens of years ago, our human touch, our fingerprints, reached no farther than Earth, or even Earth orbit (which is only about the distance from here to San Luis Obispo). Now our fingerprints reach so far that I can't even imagine the distance no matter how hard I try."

And now when he looks up, he can think not only about Deep Space 1 heading for its next encounter with a comet, about the Galileo spacecraft exploring the Jupiter system, about Mars Pathfinder and the Viking Landers still sitting up there on the surface of Mars, he can look for his very own piece of the sky, Asteroid Rayman.

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Asteroid Sidebar

IMAGE OF ASTEROID RAYMAN

Asteroid Rayman, formerly known as 10050 1987 MA_1, appears as a short, thin streak in the center of the image above, which is a one-hour exposure from the 48-inch Schmidt telescope at Palomar Observatory. Dr. Eleanor Helin and her team on the Palomar Planet-Crossing Asteroid Survey are credited with the discovery of this asteroid, along with several thousand other asteroids of all types.

Asteroid Rayman orbits between Mars and Jupiter, with a period of about 4.4 years. It is estimated to be 5 to 12 km in diameter, about the size of the asteroid that may have been responsible for the extinction of the dinosaurs 65 million years ago. Dr. Marc Rayman, for whom the asteroid has been named, says, "For now, I plan to use this awesome power for good and not for evil."

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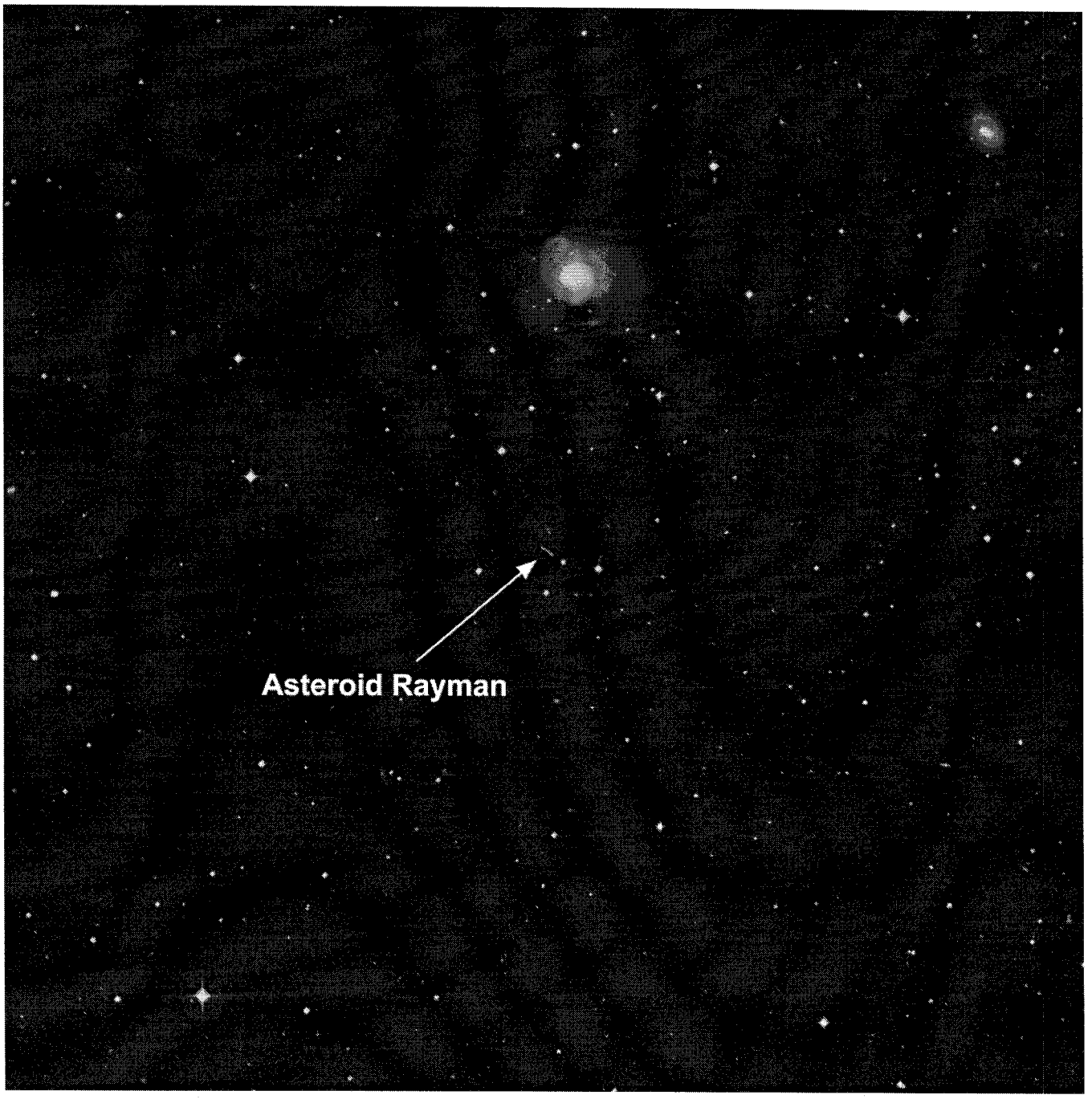
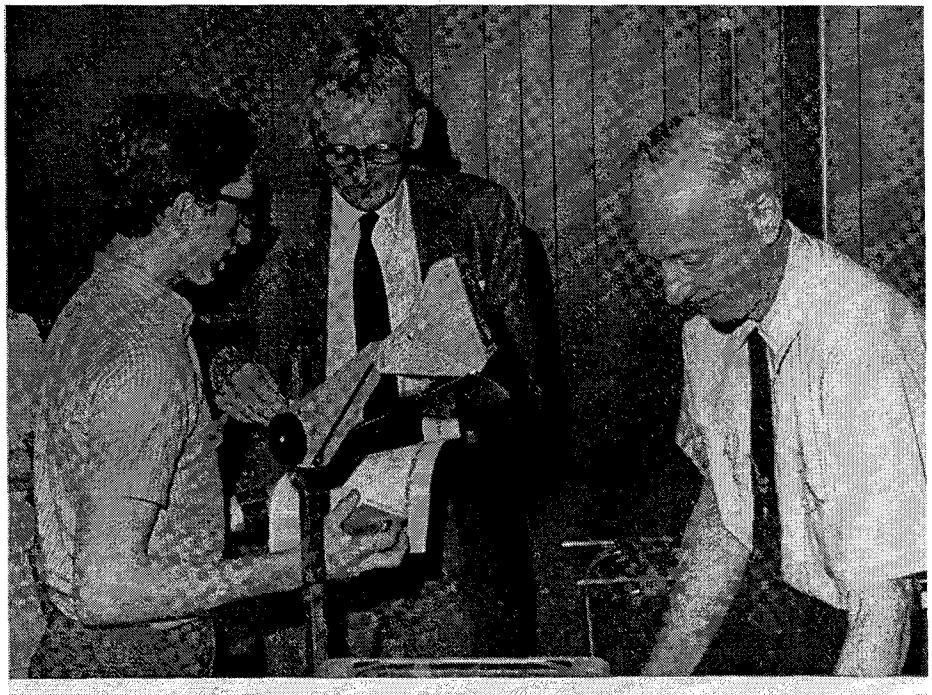

Asteroid Rayman



At the Toledo meeting Marc Rayman from Sylvania, Ohio, talks with Peter van de Kamp, while Grote Reber is at right. Other astronomers present included A. H. Delsemme, University of Toledo, and F. Miller and O. Mohler from the University of Michigan. Photograph by Jim Bilbrey.